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Species of *Aquilegia* Growing in Utah and in Adjacent Portions of Colorado, Idaho and Arizona.

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During the seasons of 1907-09, while botanizing on the Uncompahgre Plateau, Western Colorado, in the Wasatch Mountains, Central Utah, and on the Kaibab Plateau, Northern Arizona, I collected a number of *Aquilegiae*, which proved of particular interest especially so far as the distribution of the species is concerned. Of the species listed by Dr. Rydberg for Colorado, I observed particularly *A. coerulea*, *A. elegans*, *A. micrantha*.

The first mentioned appears to be not only the most widely distributed species but has also the distinction of being the State flower of Colorado. It occurs throughout Colorado at the higher elevations, usually at 2400 m. and upwards and is very abundant in places on the Uncompahgre Plateau, where I have observed it. This handsome species was first mentioned by James (Long's Expedition, 2:15, 1823) and later described by Doctor Torrey (Ann. Lyc. N. Y. 2:164, 1828). It is readily recognized by its large bi-colored flowers, the sepals being light blue, the petals blue and white. It was illustrated by Hooker (Bot. Mag. 90:t. 5477, 1864), and is too well known to require a description here.

In the Wasatch Mountains we find a white form growing under practically the same conditions as the Colorado plant and differing in no particular from the latter except in the color of the sepals. It was first noticed by Nuttall and described by him under the name *A. leptocera* (Nutt. in Journ. Acad. Sc. Phila. 7:9, 1834) and also illustrated by Hooker (Bot. Mag. t. 4407, 1848). It was described by Doctor Gray as *A. coerulea* var. *albiflora* (Robinson, Gray Syn. Fl. 1:44 1895). At first I thought the Utah form merited recognition as a species but on August 27, 1908, while botanizing on the slopes of Mount Terrell, Central Utah, I met with typical *A. coerulea* growing with the typical Utah form and varying in

* April 15, 1910.—Pages 165 to 196.

to the latter. With white forms occasionally observed in Colorado amidst typical plants and the reverse obtaining in Utah, no definite specific line can possibly be drawn between the two forms, so Doctor Gray's name is not only appropriate for the Utah form but it is also indicative of its relationship to *A. coerulea*. The forms appear to thrive best in the Aspen region.

On June 27, 1909, while riding over the Kaibab Plateau from Ryan, Arizona, to the Grand Cañon, I observed a very graceful form of an *Aquilegia* hitherto unknown to me. It is frequent in the vast *Pinus ponderosa* area for which the plateau is famous; its position in the system appears to lie between the *A. coerulea* group and *A. chrysanthra*. To the former it is related by its sometimes faintly bluish sepals while the long and very slender spurs remind one of *A. chrysanthra*. The latter species I collected in April, 1908, on a similar yellow pine (*Pinus ponderosa Mayriana*) area in the Huachuca Mountains, Arizona.

Aquilegia pinetorum nov. sp.

In *A. chrysanthra* the length of the sepals to that of the spurs may be expressed by the ratio 7:11, while in the new form the relation is 3:7, or, reduced to a common denominator, the relations will be expressed by 6:10 and 4:10 respectively. In *A. coerulea* the relation is 7:10. It is true that the length of the spur in *A. chrysanthra*, and for that matter in many if not in all of the "spurred" species, is a variable quantity; yet the differences are too great to allow our form to be referred to either *A. coerulea* or *A. chrysanthra*. The petals in *A. chrysanthra* are commonly 12 mm. in length (excluding the spurs), with a rounded or broad and somewhat truncate apex. In our form, on the other hand, the petals approach more nearly the form and size of those of *A. coerulea*. The following diagnosis will serve to further elucidate the species.

Herba perennis, 4 dm. v. altior: caules pauci e caudice crasso, supra ramosi, pubescentes v. glabori: folia basilaria numerosa, 2-ternata; petioli graciles, 10-15 cm. longi, basi dilatati; petioli secundarii paene filiformes, 1-4 cm. longi, petioluli filiformes, 0.5 - 1 cm. longi, pubescentes; foliola 2-3-fida, segmentis inciso-rotundato-lobatis, basi rotundata v. cuneata, supra viridia subtus glaucescentia; caulinia minora ternata, simpliciora: flores magni (*A. coerulea* minores) albi; sepala ovato-oblonga, acuta, basi contracta, 3 cm. plus minusve longa, alba v. saepe coerulea; petala spatulata, apice rotundata, calcaribus rectis, tenuibus, 7 cm. plus minusve longis; stamina petala superantia, inaequalia, antheris oblon-

gis, 2 mm. longis; staminodia membranacea; ovaria pubescens, stylis rectis stamina superantibus; folliculi ignoti.

Hab. In the *Pinus ponderosa* area, Buckskin Mountains, Northern Arizona. (Tidestrom, no. 2328, June 28, 1909.)

There is another species, *A. longissima* Gray, which is still more remarkable on account of the length of the spurs. In this species we find the spur sometimes over 1 dm. in length and the relation of the length of the sepals to that of the spurs is sometimes 2.5:10. Of *A. longissima*, I have seen only two specimens, one collected by Dr. E. Palmer in the Caracol Mountains, Coahuila, Mexico, and the other by Dr. V. Havard, in Los Chisos Mountains, Texas, near the Mexican boundary. *A. longissima* differs from our plant by its greater height; by its much larger leaves, with petioles sometimes 3 dm. or longer; and by its linear-oblong sepals.

On August 22, 1908, while riding over the Wasatch Plateau, near the eminence called Wasatch Peak, I met with another *Aquilegia* which does not appear to be related to any of the above mentioned species. It grew at an altitude of 3150 m., in the sand and among the gravel and loose rock which is so characteristic of certain slopes in the Wasatch Mountains. The plant is apparently sub-alpine and very rare, since I have not seen it in other similar localities,—not even on the Big Horse Shoe Summit (3600 m. alt.), some twenty-five miles northward, nor on Mount Terrell (3300 m.). The following is the diagnosis of our form:

Aquilegia scopulorum nov. sp.

Herba perennis, glabra v. supra pubescens, 1-2 dm. alta, multicaulis e radice crassa: folia basilaria 2-ternatisecta; petioli 4-6 cm. longi, basi dilatati; foliola conferta, sessilia, coriacea, venis obscuris, rotundata, basi truncata, trifida, v. lobata, 1 cm. plus minusve lata; caulinia ternata, simpliciora: flores albo-lutei v. albo-coerulei; sepala ovato-oblonga, pallide purpurea saepe coerulea; petala oblonga, apice rotundata, albida; calcaribus tenuibus, 3-5 cm. longis: stamina petala aquantia: ovaria pubescens; styli tenues, 5 mm. longi; folliculi ignoti.

Hab. On gravelly slopes, Wasatch Peak, Central Utah. (Tidestrom, no. 1788, Aug. 22, 1908.)

This plant differs from *Aquilegia coerulea* var. *calcarea* Jones, by its caudine leaves, which in the latter form are 3-sected, with the lobes oval and entire. As to the leaf-form, f. *calcarea* is more closely related to *A. scopulorum* than to *A. coerulea*. In our plant the petioles as well as the leaf-blades and lower part of the stems are glabrous and glaucous. Mr. Jones, however, describes his form as having "petioles

very glandular-hairy, as well as the stems and peduncles." Mr. Jones found his form on a *Pinus ponderosa* area at an elevation of 2100 m., near Cannonville, Southern Utah, but our plant belongs to a region over 100 miles northward and grows at an elevation of nearly 3100 m.

July 8-9, 1908, while riding over the Wasatch Plateau towards Emery, Utah, I had the good fortune of traversing territory which hitherto has lain outside of the beaten path of botanists. While the plants of the plateau are fairly well known, since many species range northward and abound in more accessible regions; a great deal remains to be done in exploring the rugged regions immediately to the east and below the plateau. This region is marked by most rugged "box-cañons," of which "Muddy Creek Cañon" might be cited as a fair example. A little to the south of the latter lies one of the most inaccessible and, up to within two years, impassable, steep and very abrupt cañons. A trail, recently constructed by the Forest Service, enables one now to pass through this interesting region.

From the plateau (approximately 300 m. alt.) one descends the Muddy Creek onto a lower, smaller plateau-like area which is open for a distance of some six or seven miles and covered with a dense *Pinus scopulorum* forest eastward to a line where the "slope" is almost precipitous.

The cañon referred to above is one of the few means of descent from the plateau to the "eastern" desert. Here I found a number of interesting plants among which is the following:

Aquilegia rubicunda nov. sp.

Herba perennis pubescens, 1-3 dm. alta; caules pauci e radice crassa; folia basilaria petiolis elongatis 3-ternati-secta; petioluli filiformes; foliola 1 cm. plus minusve longa, basi truncata v. cuneata, segmentis cuneata tridentata v. varie lobata, lobis rotundatis: caulinia simpliciora; flores luteirubricundique; sepala avata acuta, rubicunda, 1 cm. plus minusve longa; petala spatulata, pallide lutea, apice rotundata 5-7 mm. longa, calcaribus gracilibus 2 cm. longis; stamina petalis du-
plo longiora; ovaria glabra, styli tenues; folliculi ignoti.

Hab. Among rocks along the "Link Trail," Manti Nat. Forest, Utah, near Emery. (elev. 2400 m.)

This form, which I at first referred to *A. elegantula* is distinguished from the latter by its uniformly tapering spurs and pink-colored sepals.

* *Flowers red with some yellow and green.*

† *Plants 3 dm. more or less in height, leaf-segments small.*

1. *A. elegantula* Greene, Pitt. 4:14, 1899. Rydb. Fl. Colo. 136, 1906.

Leaves mostly basal on long, slender petioles; flowers commonly 2 cm. in length, pendulous in anthesis; sepals ovate-oblong, greenish, 1 cm. long; the yellow laminae of the petals one half as long as the somewhat saccate, curved spurs; ovaries pubescent, style 15 mm. in length.

Southern Colorado. Mount Carbon. (Tm. 2202).

†† *Plants taller, leaf-segments large.*

Spurs tapering uniformly.

2. *A. rubicunda* Tm.

Leaves on slender petioles sometimes 2 dm. long; flowers commonly 3 cm. in length, pendulous in anthesis; sepals oval, acute, pinkish, 1 cm. long; the light yellow laminae of the petals one-fourth as long as the slender spurs; ovaries glabrous.

Wasatch Mts., Central Utah. (Tm. 2400.)

Spurs somewhat saccate curved.

3. *A.formosa* Fischer in DC. prodr. 1:50, 1824. T. & G. Flora 1:30, 1838. Planch. Fl. des Serres 8:125, t. 795. Gray, Syn. Fl. 1:44, 1895.

A. canadensis var. *formosa*. Wats. Bot. King's Exp. 10, 1871.

Leaves on long petioles; lateral leaflets nearly sessile, the terminal short-stalked; flowers nearly 3 cm. in length, pendulous in anthesis; sepals ovate-lanceolate, acute, 1 cm. or longer; the yellow, truncate or rounded laminae of the petals 5 mm. or longer, the red spur twice as long: ovaries pubescent, styles 1 cm. or longer.

Western Utah and Idaho and westward. (Sawtooth Mts. Idaho. Tm. 2560 and 2785.)

** *Flowers blue with some white or varying to white.*

† *Flowers small.*

4. *A. saximontana* Rydb. in Gray, Syn. Fl. 1:43, 1895; Fl. Colo. 136.

Glabrous, 2 dm. more or less in height; leaves small; sepals oval-oblong, 1 cm. in length; the yellow laminae of the petals somewhat shorter than the sepals and exceeding the blue, hooked spur; ovaries glabrous.

Colorado.

†† *Flowers large.*

§ *Spurs 3 cm. more or less in length.*

a. Sepals light blue.

5. *A. coerulea* James in Long's Exp. 2:15, 1823. Torr. Ann. Lyc. N. Y. 2:164, 1828. Hook. Bot. Mag. t. 5477. 1864. Gray, Syn. Fl. 1:44, Rydb. l. c. 136.

3-6 dm. in height; sepals ovate-oblong, 2.5-3.5 cm. in length, the white laminae of the petals rounded, one-half as long as the blue, slender spurs.

Aspen and Spruce Regions, Colorado. Mount Terrell, Utah. (Tm. 1815.)

aa. Sepals white.

6. *A. coerulea albiflora* Gray, Syn. Fl. 1:44, 1895.

A. leptocera Nutt. Journ. Acad. Phila. 7:9, 1834.

A. leptoceras Hook. Bot. Mag. 1. 4407, 1848.

A. coerulea Wats. Bot. King's Exp. 10, 1871.

A. coerulea var. *ochroleuca* Hook l. c. under t. 5477.

This form appears to differ from *A. coerulea* only in its white sepals.

Aspen and Spruce Regions, Wasatch Mountains, Utah.

§§ Spurs 6 cm. or longer.

7. *A. pinetorum* Tm.

Differs from the preceding species by its more slender form and much longer spurs.

Pinus ponderosa Region, Buckskin Mts., Arizona. (Tm. 2339.)

*** Flowers blue with some purple, yellow or cream-white or entirely purplish white.

† Glabrous below, sometimes pubescent above.

8. *A. scopulorum* Tm. (Plate XI.)

1-2 dm. high from a multicarpital caudex; leaves small, leaflets crowded; sepals ovate-oblong, blue or pale purple; petals oblong, whitish; spurs slender, 3-5 cm. in length; ovaries pubescent; styles slender, 5 mm. long.

Subalpine Regions, Wasatch Mts. Utah. (Tm. 1788.)

†† Glandular-hairy.

9. *A. scopulorum* f. *calcarea* (Jones) Tm.

A. coerulea var. *calcarea* Jones, Proc. Calif. Acad. Sc. Ser. II, 5:619, 1895.

Pinus ponderosa area near Cannonville, S. Utah, alt. 2100 m. Jones.

**** Flowers yellow.

† Spur wanting.

10. *A. Eastwoodiae* Rydb. Bull. Torr. Bot. Cl. 29:146, 1902; Fl. Colo. 136.

A. ecalcarata Eastw. Zoe, 2:226, 1891; 4:3, 1893; Cal. Acad. Sc. Ser. II, 4:560, t. 18 in 1895. Gray, Syn. Fl. 1:43.

I have seen no specimens of this species.

S. W. Colorado.

†† *Spur 2 cm. or shorter.*

§ *Glandular-pubescent.*

11. **A. micrantha** Eastw. Proc. Calif. Acad. Sc. Ser. II, 4:559, t. 19. Gray, Syn. Fl. 1:43. Rydb. l. c. 136.

A slender species, 3 dm. or taller; leaves on short petioles; flowers 2 cm. or somewhat longer; sepals ovate-oblong, acute, 1 cm. long; petals truncate or nearly so, spur slender: follicles 1 cm. or somewhat longer, viscid-pubescent.

In cañons, S. E. Utah and southward.

§§ *Glabrous or nearly so.*

12. **A. flavescens** Wats. Bot. King's Exp. 10, 1871. Gray, Syn. Fl. 1:43.

A. canadensis var. *aurea* Regel, Gartenfl. 21:t, 734.

5 dm. or higher, branching; leaves on long petioles; sepals ovate-oblong, spreading, 1.5-2 cm. long; the broad laminae of the petals one-half as long as the somewhat curved spur; follicles 2 cm. in length, pubescent.

Aspen and Spruce Regions, Wasatch Mountains, Utah.

A. flavescens f. **minor**, Subalpine, smaller and more hairy. Wasatch Plateau. (Tm.)

††† *Spur 4 cm. or longer.*

13. **A. chrycantha** Gray, Proc. Am. Acad. 8:621, 1873; Syn. Fl. 1:44, Masters, Gard. Chron. 1873, f. 304, Rydb. l. c. 137.

A. leptocera var. *chrysanthia* Hook. f. Bot. Mag. t. 6073, 1873.

5 dm. or taller, glabrous below; sepals lanceolate-oblong, 2 cm. or longer; the slender spur about four times as long as the broad laminae of the petals; follicles 2 cm. or longer.

Southern Colorado and southward.

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An Analytic Study of Faunal Changes in Indiana.

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REPTILES AND AMPHIBIANS.

We have less direct evidence regarding present and former numbers of these classes than any other conspicuous group in our fauna. Several local histories mention snakes and es-

pecially, the abundance of rattlesnakes. There is no direct evidence as to comparative abundance of the smaller snakes, turtles, frogs and salamanders of the past and present. Their ecological position gives us some idea as to whether they are increasing or diminishing.

Snakes are universally disliked and most people will kill them whenever possible. Three venomous species were not uncommon in the State. The copperhead was abundant in the southern half, the prairie rattlesnake in the northern half and the banded rattlesnake was not uncommon in all parts. At the present time the latter species is practically extinct, the copperhead is rarely found except in rugged, uncultivated localities and the prairie rattler is limited to the vicinity of swamps and marshes.

These species have been systematically hunted down by man in defense of himself and his property. Other species that are reported venomous, as the black snake or blue racer, and the hog nosed snake or spreading viper have shared their fate.

The garter snakes and water snakes are much more prolific, and being rather timid and living chiefly in rank vegetation, not near houses, they have maintained their place in the fauna much better. All species have suffered destruction by hogs and it is doubtful whether any of the more common serpents are as numerous now as a century ago.

Turtles also have diminished in abundance. Hogs eat them as well as snakes (Culbertson, '07), and probably exerted a very great influence upon the reptilian and amphibian fauna in the days when they were permitted the freedom of the woods. Ponds and marshes have been drained, creeks have dried as the result of deforestation, and lake shores which were formerly used as breeding grounds by turtles are now occupied by human habitations. All of these things have tended to diminish their number.

Amphibians have been acted upon by the same influences as turtles. There is this difference, however, turtles were practically immune from attack by wild creatures of the forest. Frogs and salamanders were eaten by snakes, waterfowl, opossums, raccoons and other carnivorous animals. Most of these species have been greatly reduced and hence the frogs have lost many enemies. Man is not usually an active enemy of these creatures, hence his influence upon them is principally indirect and consists in draining swamps and reducing land

to cultivation. As there are pools of water left in every community, the animals are not entirely dispossessed of breeding places. On the whole, it does not seem probable that the amphibians have greatly diminished in number as a result of the settling of the State.

FISHES.

Fishes, both large and small, were abundant in the waters of Indiana during the early days of settlement. The shovelnosed sturgeon, paddle fish, buffalo, alligator-gar and many others grew to considerable size and contended for supremacy in the rivers and streams of the southern part of the State, while muskallunge, whitefish, lake sturgeon, cisco and others were abundant in the northern lakes. The pioneers speared, gigged, trapped and seined them without let or hindrance. Naturally, the best time to capture many of them was while they were ascending the smaller streams to spawn. By the light of torches or blazing bonfires along the bank many pounds of fish could be speared or gigged in a single night. But they were often taken before spawning and the next generation was lost. The only possible result was the diminution of many of the larger species.

Large fish live for the most part upon the smaller ones. How have these fared? Have they been given added opportunities as some of the smaller birds and mammals have?

The problem is not by any means the same, for the fish fauna is closely dependent upon the character of the streams as well as food and protection. In the northern part of the State there were many lakes, some of them quite deep, some mere marshes, but all with more or less of shallow, reedy margins. The outlets were generally sluggish and consequently more or less choked by aquatic plants. The shallow parts of the lakes are easily drained and make exceedingly fertile land. In many places lake levels have been lowered several feet by cutting ditches and straightening the channels of the outlets. At other points, entire lakes or marshes have been drained in the same way; the most notable instances being Beaver Lake and English Lake. The water area in this region has therefore been considerably lessened and drainage has often progressed rapidly enough to destroy large colonies of aquatic plants and animals, thereby lessening the food supply for the fishes and occasionally killing fishes themselves.

In the southern part of the State there were few lakes and marshes but many streams. Deforestation has had a tremendous influence upon the character of the streams. The one that has been longest familiar to the writer is Willow

Creek, in Ohio County. This is a small stream with a bed in shale and soft limestone. Twenty years ago the hills bordering it were almost all covered by forests. The creek had many pools two or three feet deep and from one to several rods long. The stream flowed most of the year and even during droughts the pools contained much water, pure enough to afford homes for fishes. The stream was too small to support large species, but bullheads, sunfishes and several species of minnows and suckers were abundant and were frequently caught on hook and line.

At the present time the forests are cleared and all the hills bordering the stream are under cultivation unless too rocky and barren to produce a crop. The stream has lowered its bed noticeably (probably two feet on the average in 20 years) and the character of the stream is greatly changed. Now it flows only during the wet months of the year, ceasing soon after the flow of surface water is exhausted, but becoming a raging, unfordable torrent after heavy rains. The floods have changed the character of the stream, bed so that large pools no longer occur in times of drought only a few small, stagnant pools, fed by seepage from springs, can be found in the entire course of the stream. These contain no fishes large enough to take the hook, and only one or two small species of minnows inhabit them.

Willow Creek is here described because the writer has personal knowledge of the facts. It is typical of all the smaller streams that have cut their beds in the Ordovician rocks of southern Indiana and more or less typical of small streams throughout all the southern part of the State. Paradoxical as it at first seems, destruction of the forests has meant destruction of the fishes.

I know of but one direct comparison that has been made between past and present fish fauna of the same stream, and that has not been published heretofore. In 1885, and a few years previous, Eigenmann and others made extensive collections in Bean Blossom Creek, a tributary of White River, not far from Bloomington, Indiana. Altogether, 40 species were taken, 32 of them being collected in one day, September 12, 1885. In 1904 three experienced and energetic collectors, Dr. A. M. Banta, now of the Cold Spring Harbor Laboratory, of the Carnegie Institution; Dr. Newton Miller, now of Clark College, and W. L. McAtee, now of the Biological Survey, of the U. S. Department of Agriculture, collected fishes in the same stream with avowed intention of breaking the record for number of species. Collections were made on but a single day, May 24, and although their results might not compare with the list of Eigenmann, collected through a period of

several years, it should be as large as that taken in a single day nineteen years earlier, unless there was a change in the fauna.

The list of Banta, McAtee and Miller includes only twenty-four species, of which twenty-one were taken by Eigenmann and three are new to the stream.

The following is Eigenmann's list of 1885 with his comments upon their abundance. The nomenclature is not corrected to date but the common names are added. The species that were taken again in 1904 are checked thus *.

1. *Ammocoetes branchialis*, Brook lamprey. Abundant in spring.
2. *Noturus gyrinus*, Tadpole Cat. Two specimens.
3. **Noturus miurus*, Brindled Stonecat. Very abundant.
4. *Noturus flavus*, Stonecat. Very common.
5. *Noturus exilis*, Slender Stonecat. One specimen.
6. *Leptops olivarius*, Yellow Cat.
7. *Ameiurus melas*, Black Bullhead.
8. **Ameiurus natalis*, Yellow Bullhead.
9. **Catostomus teres*, Common sucker. Very abundant.
10. *Catostomus nigricans*, Hogsucker. Abundant.
11. **Minytrema melanops*, Spotted sucker. Abundant.
12. **Moxostoma macrolepidotum*, Red Horse.
13. **Campostoma anomalum*, Stone-roller.
14. *Chrosomus erythrogaster*, Red-bellied Dace.
15. *Hybognathus nuchalis*, Silvery Minnow.
16. **Notropis whipplii*, Silverfin.
17. **Notropis megalops*, Common Shiner.
18. **Notropis ardens lythrurus*, Blackfin.
19. *Rhynichthys atraeas*, Blacknosed Dace.
20. *Hybopsis biguttatus*, River Chub.
21. **Hybopsis amblops*, Silver Chub.
22. *Semotilus atromaculatus*, Horned Dace.
23. *Esox vermiculatus*, Little Pickerel.
24. *Labidesthes sicculus*, Brook Silverside. One specimen.
25. *Aphredoderus sayanus*, Pirate Perch. One specimen.
26. *Pomoxys annularis*, White Crappie. Very abundant.
27. *Pomoxys sparoides*, Calico Bass.
28. **Ambloplites rupestris*, Goggle-eye.
29. **Lepomis cyanellus*, Blue Sunfish.
30. **Lepomis megalotis*, Long-eared Sunfish. Abundant.
31. **Micropterus dolomieu*, Black Bass. Abundant.
32. **Boleosoma olmstedi maculatum*, Johnny Darter. Abundant.
33. *Diplesion blennoides*, Green-sided Darter. Abundant.
34. **Percina caprodes*, Log-Perch. Abundant.
35. **Hadropterus phoxocephalus*.

36. **Hadropodus scierus*. Abundant.
37. **Hadropodus aspro*.
38. **Etheostoma flabellare*, Fan-tailed Darter. Abundant.
39. **Etheostoma coeruleum*, Rainbow Darter.
40. *Uranidea richardsoni*, Miller's Thum.

In addition the 1904 collection contained *Ericymna buccata*, Silver-mouthed Minnow; *Pimephales notatus*, Blunt-nosed Minnow, and *Phenacobius mirabilis*, Sucker-mouthed Minnow. Nineteen of the forty species taken in 1884 and 1885 were not found in the same stream 20 years later.

Nine of these, or 40 per cent., are large enough to be caught on a hook and the others, or 55 per cent., are too small to be taken in that way. Of the species that have disappeared, three small and two large ones were formerly abundant in the stream, three small ones were rare and the abundance of the others is not noted. Altogether, twelve of the nineteen species are either abundant or at least of common occurrence in this region, while the other seven are not very common.

Classified on the basis of food*, eleven of the exterminated species subsisted chiefly on animal food, five are either omnivorous or feed principally on mud, and the food of three is unknown to me.

Twenty-four species were taken in 1904. Of these eight, or $33\frac{1}{3}$ per cent., are large enough to be taken by fishermen and 16, or $66\frac{2}{3}$ per cent. are too small to take the hook. Twenty-two, or over 90 per cent, are common fishes of the region. Two species are rather rare. One of these, *Hadropodus scierus*, was first described from this stream and has since been taken in several states of the Mississippi basin, but is not as common as many of the darter family, of which it is a member. The other is the sucker-mouthed minnow, *Phenacobius mirabilis*, not heretofore reported from Indiana, but rather common in Illinois and farther west. Apparently it is migrating eastward.

Twelve of the collection of 1904 are reported to subsist principally on food of an animal nature, while five eat a considerable amount of vegetable matter. The food of the others is not known, but the majority of them probably subsist wholly or largely on animal food. In both lists, the great majority of fishes are those that prefer clear streams and rocky or sandy bottoms, as might be expected in a comparatively swift, rocky creek.

The presence of *Phenacobius mirabilis* is interesting although it may be without special significance. If the eastward migration of this species is part of a general movement, it is of extreme interest. The certainty of an eastward movement of birds has been pointed out and also the probability of such

a movement among mammals. Something similar is going on among the insects. In each of these classes it is undoubtedly the result of deforestation, but if there is a similar movement of the fishes, it is far more difficult to explain.

A comparison of percentage given above for the two periods seems to indicate that small species have a slight advantage, and that species numerous in the region are more apt to survive than those that are rare, without regard to their abundance in any particular stream. No tendency with regard to food is evident. It is of interest to note that but two of the seven cat fishes occurring at the earlier period were found at the later date, while only one of the eight darters had disappeared.

The data are insufficient to warrant any sweeping conclusions but a reduction in the number of species has taken place without question and it is, perhaps, the most significant fact to be learned from this study.

MOLLUSCA AND CRUSTACEA.

There is little information as to the former abundance of these two groups. Land snails are most abundant in the woods under decaying logs and leaves. With the exception of the slugs, they are not very common in cultivated or grassy land. It therefore seems evident that the land Mollusca are less abundant at the present time than formerly, for even in the remaining forest, the underbrush and logs are usually cleared away so that there are few places for them to deposit eggs.

Certain species of crayfishes live in burrows in marshy places more or less remote from large bodies of water. In such places they erect cylindrical stacks of mud about the entrance of their burrows and these "craw-fish chimneys" are conspicuous features of many poorly drained pastures and meadows. As land has become more valuable, these swampy places have been tiled or ditched and often placed under cultivation. Consequently they have become unfit for crustacean inhabitants and the latter must have diminished.

In the ponds, lakes and streams, the same conditions that affect the fish fauna (p. 174.) have acted upon the aquatic Crustacea and Mollusca. Deforestation has brought floods that have torn up stream bottoms in the course of an hour. Silt comes down from the hillsides by the ton and makes the water of the streams so dense that animal life can scarcely exist in them. Fishes are active creatures and have some chance of escaping into the more quiet pools and eddies, but the crayfish are sluggish and are crushed by overturning rocks and buried under debris before they can escape. Much

less can the slow moving snails and mussels escape danger where the bottom on which they rest is torn up or buried inches deep under mud or stones, or where logs, plants or other objects to which snails cling are dashed against banks or whirled away by raging torrents.

Ponds and lakes are also made turbid by the silt of plowed fields and the smaller Crustacea are smothered by the muddy water. Draining destroys marshes and annihilates aquatic plants and animals by the billion. The larger lakes and rivers are doubtless affected less than the small ones, but the character of their waters also is changed and the weaker species must suffer in consequence. In recent years the pearl mussel industry has grown so rapidly that mussels have become scarce where they were once abundant and there is danger that they may be exterminated unless the industry is regulated.

In spite of the fact that we have no recorded information in regard to the former abundance of Mollusca and Crustacea, and little knowledge of their present number, there can be no doubt that both groups have diminished. With the exception of the river mussels, none of the species of either class found in the State have any direct value to man. They furnish, however, the basis of food supply for the vast majority of fishes and are also eaten by many birds. Their diminution is therefore an economic loss, although some of the conditions that have caused them to diminish may more than counterbalance the loss.

INSECTS.

Mr. Max Ellis, of Indiana University, has contributed the data and generalizations for this section of the paper, although his notes have been rewritten to form a connected account.

Probably many insects have increased, and several have been added to the fauna, by introduction or migration. Unfortunately we have little knowledge of the vast majority of species and this account is necessarily limited to a few of the larger species and a few of considerable economic importance. During the larval stage, many insects are dependent upon one or few species of plants for food, and since they have not the ability to move rapidly or far, their presence or absence in any locality may be determined by the presence or absence of a certain plant.

Butterflies are doubtless better known than any other insects and our knowledge of their range is more complete. Blatchley ('91) has published a list of the species known to occur in the State, with localities at which they had been re-

ported. Mr. Ellis has collected in most sections of the State during the past two or three years and we therefore have a means of determining changes that have taken place during the last eighteen years.

The giant sulphur, *Callidryas ebule*, was reported only from Vanderburgh County in 1891, where a local collector, S. G. Evans, "took from one to half a dozen almost every season." Mr. Ellis took three at Vincennes in 1906, several in 1907, and several in 1908, and says that it was very common there in 1909, as many as a dozen being seen in the course of an hour. The food plants are cassia, wild senna and clover. These are not of recent introduction and the present increase of the butterfly is not due to a change in food supply but probably to a northward migration along tributaries of the Mississippi.

The black swallowtail, *Papilio polyxenes*, was said by Blatchley to be, next to the giant swallowtail, the rarest butterfly of the group. Mr. Ellis says that it is now the most abundant of the swallowtails in every part of the State, and even one of the commonest of all butterflies. The larvae feed upon the wild parsnip and other *Umbelliferae* and these are, for the most part introduced plants that have become common only in recent years.

In six years collecting Blatchley saw only two living specimens of the giant swallowtail, *Papilio cresophontes*, finding none at Bloomington, "although a constant outlook has been kept for it." Ellis says it is still our rarest *Papilio*, but it is fairly common throughout the State. He has taken it at Bloomington, Mitchell, Shoals, Vevay, Indianapolis, Anderson and Winona Lake. I have myself seen as many as fifteen in one afternoon, my zoology class having taken ten or twelve in the course of an hour between Milford and Syracuse in Kosciusko County. The food plants are the hop tree and prickly ash and these must be on the decrease, although still common in many places. The reason for the increase of the butterfly is probably a northward and eastward migration of the species. This movement was noted some years ago by Edwards.

Scudder, in 1886, reported the gray emperor, *Chlorippe celtis*, from the extreme southwestern tip of Indiana. In 1891 Blatchley reported it as far north as Wabash but said that it was scarce everywhere. Ellis found it common on the State forestry reserve at Henryville, at Anderson and at Indianapolis, abundant at Vincennes and very abundant at Vevay. The larvae feed upon the hackberry tree. The species is southern and is probably working its way northward.

The harlequin cabbage bug, *Murgantia histrionica*, is a native of Guatemala and has migrated northward through

Mexico into Texas and thence spread slowly through the southern states. (Lugger, '00.) It was south of Virginia at the time of the civil war and in 1900 had reached New Jersey and Missouri. Since 1900, probably within the past five years, it has reached Indiana. It is a serious pest, eating cabbage, turnips, and other cruciferous plants, but has not yet become numerous enough to do much harm except in the southwestern corner of the State.

The striped potato beetle, *Leptinotarsa decemlineata*, probably came from Mexico in the first place, but first migrated northward along the eastern base of the rocky mountains to Colorado. There were no suitable food plants on the plains east of that region, until they were settled and crops of potatoes were planted. This condition was fulfilled about 1850 and the beetles then began an eastward migration, reaching Indiana in 1866. Since that time it has been a serious pest.

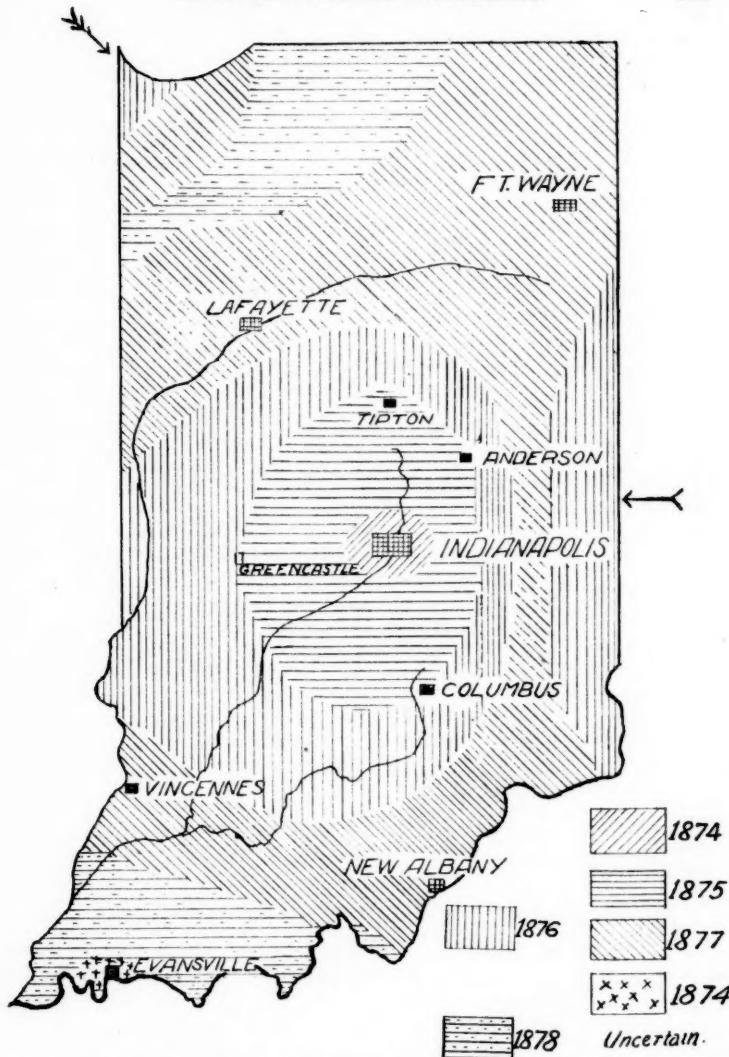
A number of insects have been introduced into the United States from Europe and have been carried to, or have migrated to Indiana.

The best known is the cabbage butterfly, *Pontia rapae*. It was introduced at Quebec in 1860 and first appeared in this State at Indianapolis in 1874. It was probably carried there by trains as the nearest point at which it was then known was Columbus, Ohio.

It spread from Indianapolis during 1874 and 1875, (see map), reaching Tipton, Anderson, Columbus and Greencastle during the latter year. In 1876 the main army, migrating through Ohio, reached Indiana and the next year the two divisions were united in the eastern part of the State. In 1876 the species also entered the northwestern part of the State from Chicago, and in 1878 this colony became joined to the main vanguard and the species had completely covered the State. The principal direction of migration of this species was westward, contrary to the usual course of the native species of the region. (Account based on Scudder, Butterflies of New England.)

The horn fly, *Hematobia serrata*, which is a pest on cattle during the summer, and the grape berry moth, *Eudemis botana*, were also introduced from Europe, the former about 1886, the latter much earlier. The horn fly spread rapidly, reaching Indiana in about two years, and soon overspread all of the region east of the Rocky Mountains. The grape berry moth spread slowly and reached this State during the late nineties.

The San José scale was introduced into California about 1870. It was not discovered in the east until 1893, when it



Sketch map of Indiana showing the rapid dispersal of the cabbage butterfly, *Pontia rapæ*. There were three introductions, one at Indianapolis, the other two at the points and from the directions indicated by the arrows. There is also an uncertain record of a fourth introduction at Evansville.

Scale about 45 miles to the inch. Adapted from Scudder.

appeared in Virginia. It was found, however, that it had been introduced into Virginia from New Jersey in 1891. (Bull. No. 3, U. S. Bureau of Entomology, U. S. Dept. of Agriculture.) The same year it was introduced into Washington County, Indiana, on apple trees shipped from New Jersey, but it was not discovered until 1894. It has since appeared in many parts of the State, but its further spread is being checked by rigid inspection.

The imported elm leaf beetle, *Galerucella luteola*, was brought to this country in 1834, but was confined to the east until 1890, when it was carried to Kentucky. Ten years later it was introduced into Indiana at Tobacco Landing, Harrison County. It spread very slowly but was carried on trees or by wagons to Elizabeth and New Middleton, and has now spread over most of the southeastern third of that County. (See map.) It is not active in flight and hence spreads very slowly, except where it is carried. It crawls a great deal, however, and hence is sometimes carried by wagon.

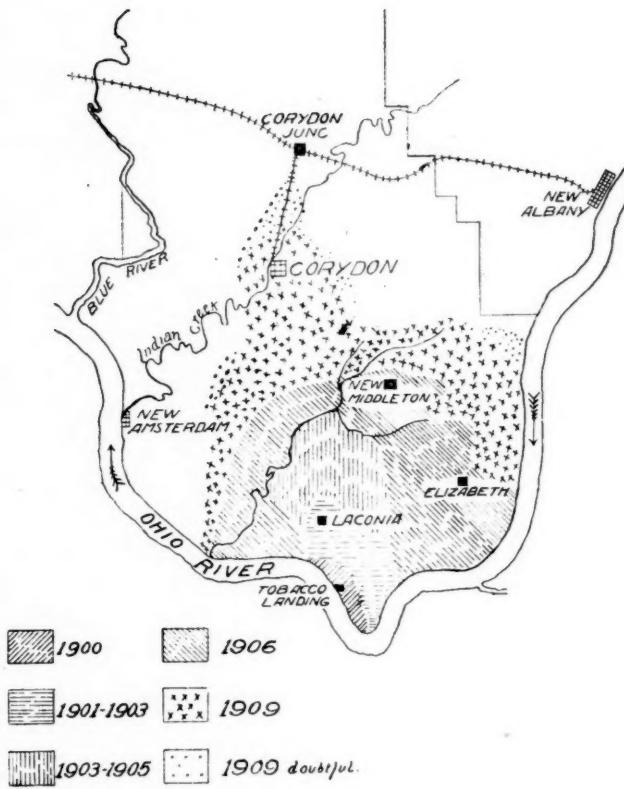
Not every species of insect has increased. No doubt wood boring beetles, and forest insects of many kinds have decreased and some have even been exterminated. But we know these so little that it is not possible to point out many instances. However, the following species are known to have decreased:

The blue-eyed grayling, *Cercyonis alope*, appears to be diminishing. Scudder ('86) included the entire State in its range. Blatchley ('91) said that it was not found south of Wabash County. Ellis says that it is now more scarce than ever, being restricted to the three northern tiers of counties. The food plants are wild grasses and sedges. The butterfly frequents swampy woodlands and is being exterminated by the draining and pasturing of these.

Hornets, yellow jackets and many wasps are less numerous than formerly. They are destroyed by man at every opportunity because of the painful wounds which they inflict. Since they live in colonies, the destruction of a large number is an easy matter. Cultivation of the soil also destroys yellow jackets and other burrowing species.

The rhinoceros beetle, *Dynastes tityrus*, was once a common inhabitant of the forest. The larvae live in decaying wood and clearing the forest has removed much of their food supply. The large size and unusual appearance of the beetle has aided in its destruction by making it an object of curiosity and fear and consequently leading people to kill it. Its slow and clumsy movements have also hastened its destruction.

The walking stick, *Diaphemora femorata*, and the rear-



Sketch map of a part of Harrison County showing the slow dispersal of the imported elm leaf beetle, *Galerucella luteola*. Scale, about eight miles to the inch. In 1906 the beetle was found around Corydon, and from 1905 to 1906 around Elizabeth and New Middleton. [Data omitted from the map by oversight.] Redrawn from the original of M. M. Ellis.

horse or praying mantis, *Stagomantis carolina*, were also common at one time. They are both of such extraordinary appearance as to attract attention and consequently both have been killed wantonly because people "do not like bugs." The former is known as the devil's darning needle and doubtless the word "devil" in association with it has created something of a superstitious fear for it. There has also been a reduction of mosquitoes and other aquatic insects, due to draining of marshy land.

To summarize the changes of insect fauna: The increase has been more marked than the decrease. A number of species have been introduced by man and some have migrated into the State. It is difficult to destroy the species that are pests because they are not easy to find, and many have a very rapid rate of reproduction. The introduced species have a good chance in the struggle for existence because they have few enemies and an abundant food supply.

The species native to the United States but new to Indiana have apparently migrated in from the south and west. The eastern migration is easily explained, as the prairie species from regions immediately west have only been able to find congenial homes and food after the forests were cleared. The northward migration is not so easily explained. May it be a part of the general northward movement of the temperate biota that followed the retreat of the ice sheet?

The insects that have diminished are aquatic or wood loving species whose homes or food have been destroyed, or they are species harmful to man, or they are of such unusual size or appearance as to attract notice.

GENERAL SUMMARY.

There is a tendency for certain ecological groups to disappear and for others to increase. Those that tend to disappear are:

1. Large species; not only have the larger species of the fauna, as bison and wapiti, disappeared, but the largest species of any natural group tend to disappear before the smaller species of the same group.
2. Aquatic species suffer from changes in the various bodies of water.
3. Forest-dwelling species are exterminated through loss of homes and food.
4. Species dangerous or supposedly dangerous to man are killed off.
5. Species economically injurious are actively destroyed whenever possible.

6. Species valued for sport or for any animal product are killed and tend to disappear; not one species native of Indiana has been domesticated.

7. Species that breed slowly tend to disappear. (These are usually large species with few enemies.)

8. Species with gregarious habits are more easily killed than those with solitary habits, hence tend to disappear.

The groups that tend to remain stationary or to increase are the following:

1. Small species.
2. Species that have a high birth rate.
3. Species that have: (a) great cunning, or (b) great timidity.

4. Prairie Species: there is unquestionable evidence of an eastward movement of the fauna, due to deforestation, and some indication of an unexplained northward movement.

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Our Birds in August and September.

BROTHER ALPHONUS, C. S. C.

The autumn migration of certain species among the birds presents some inexplicable facts to the writer. He is unable to ascertain why the Cowbird, Red-winged Blackbird and Purple Grackle should leave even before the end of summer. They, being among the early spring arrivals, should naturally depart later, when most of the first spring migrants do. Another curious thing is the total absence of the Spotted Sandpiper from his summer haunts along the shores of lakes before he really migrates south. I have found this species near rivers long after leaving the lakes.

Certain species are absent from this locality for a considerable period and then reappear—some seldom and others often. Among the former are the Redstart, Phoebe, Nighthawk and Chickadee; among the latter is the Towhee. The writer is equally unable to account for the strange movements of these species.

As the season of migration advances, the various species that were abundant during summer begin to appear irregularly. This fact leads the writer to surmise that most of the species migrate gradually and in small numbers, leaving gaps in their distribution. Even those that migrate in large flocks do not disappear altogether. Individuals may be seen here and there for several days after the main body has departed.

Birds seen every day:

Song Sparrow

Chipping Sparrow

Blue Jay

Birds not seen on any day:

Crested Flycatcher

Scarlet Tanager

Dickcissel

Yellow Warbler

Rose-breasted Grosbeak

Whip-poor-will

Phoebe

Nighthawk

Bobolink

Bobwhite

Birds seen every day except on the dates after their names:

Yellow-billed Cuckoo, 24, 28, 31. Sept. 4, 6, 8, 14, 18, 24 to 29. Flicker, 14, 23. Sept. 5, 6, 8, 14, 15, 18, 23, 24, 27, 28, 30.

Red-headed Woodpecker, Sep. 12 to 16, 18, 20, 21, 23 to 30. Meadowlark, 14, 15, 24, 25, 27, 28, 29. Sept. 1, 2, 7, 8, 9, 12, 14, 16 to 20, 22.

Chimney Swift, 24, 29. Sept. 4, 7 to 11, 13 to 17, 19 to 27, 29, 30. Warbling Vireo, 14, 15, 20, 21, 24, 26. Sept. 3, 4, 9, 16 to 30.

Wood Pewee, Sept. 12 to 17, 19 to 22, 24 to 30. Purple Grackle, 14. Sept. 5, 9 to 13, 15 to 30.

Baltimore Oriole, Sept. 1, 2, 4 to 30. Barn Swallow, 14, 17, 19, 23, 24, 26, 27, 29. Sept. 4, 6 to 30.

Goldfinch, 21. Catbird, 14, 28. Sept. 14, 23, 24, 26 to 30.

Field Sparrow, 23, 28. Sept. 4, 5, 6, 9, 11 to 17, 21, 22, 23, 25 to 30. Robin, Sept. 10, 14, 16, 17, 18, 28.

Indigo Bird, 21, 27, 28, 30. Sept. 2, 9, 10, 11, 15, 16, 26 to 30. House Wren, 20, 23 to 26, 28. Sept. 3, 5, 10, 13, 14, 16, 18, 19, 21, 22, 25, 26, 28, 29, 30.

Cedarbird, 14 to 17, 20, 21, 23, 24, 26 to 28, 30. Sept. 6, 9, 11, 13, 15, 17, 18, 21, 23 to 30. Mourning Dove, 16, 21, 24. Sept. 2, 3, 6, 10, 12 to 21, 24, 25, 26, 28, 29, 30.

Brown Thrasher, 14, 27, 30. Sept. 9, 24, 30. White-breasted Nuthatch, 14, 30. Sept. 3, 5, 6, 13, 14, 16, 20, 22, 23, 26 to 30.

Belted Kingfisher, 14, 15, 18, 19, 20, 22, 24, 30, 31. Sept. 4, 6, 7, 8, 11, 13 to 17, 19, 24, 26, 29, 30. Downy Woodpecker, 14, 15 to 18, 21, 22. Sept. 1, 2, 4, 8, 13, 15, 17, 18, 21, 26, 28, 30.

Kingbird, 27. Sept. 2 to 30.

Crow, 14, 24. Sept. 6, 13, 16.

Birds seen on the dates after their names:

Screech Owl, 18, 20, 22, 23, 26, 28, 30. Sept. 2, 6, 7, 8. Swamp Sparrow, 15, 16, 18, 21, 23. Sept. 3.

Cowbird, 14, 15, 16, 17. Spotted Sandpiper, 22, 27.

Orchard Oriole, 17, 19, 22, 24, 29, 31. Sept. 1. Chickadee, 17, 27, 31. Sept. 12.

Yellow-throated Vireo, 18, 19, 27. Sept. 17. Eave Swallow, 17, 19. Sept. 1.

Cardinal, 22. Hermit Thrush, 29. Sept. 7, 9, 10, 12, 15, 16, 24, 29.

Bluebird, 21, 22, 27. Sept. 3, 7, 10, 12, 17, 26, 28. Least Flycatcher, 27. Sept. 3, 10.

Long-billed Marsh Wren, Sept. 7. Purple Martin, 14 to 27, 19, 22, 24, 28. Sept. 7.

Birds seen on the dates after their names:

Alder Flycatcher, 26.
 White - crowned Sparrow, Sept. 24, 25, 28.
 Nashville Warbler, Sept. 25.
 Golden - crowned Kinglet, Sept. 25 to 30.
 White - throated Sparrow, Sept. 28, 29, 30.
 Hummingbird, 15, 21, 22, 26. Sept. 1, 2, 3, 4, 6, 7, 8, 10, 11.
 Red-winged Blackbird, 25.
 Vesper Sparrow, 17, 18, 19, 28. Sept. 3.
 Red-eyed Vireo, 17, 20, 23. Sept. 2, 17.
 Towhee, 17, 20. Sept. 2.
 Maryland Yellowthroat, 20, 26. Sept. 2, 4, 5, 6, 11, 16, 17, 20.
 Loggerhead Shrike, Sept. 5.
 Killdeer, 22. Sept. 6, 16, 20, 21, 22, 24, 26, 27, 29.
 Redstart, 29. Sept. 20.
 Yellowlegs, 14, 19, 21, 22, 28. Sept. 2, 5, 12 to 17, 19, 21, 23.
 Black-billed Cuckoo, 19, 27, 30. Sept. 10, 29.
 Tree Swallow, Sept. 1.
 Hell Diver, Sept. 8, 21.
 Hairy Woodpecker, Sept. 5.
 Yellow Palm Warbler, Sept. 15, 29.
 Myrtle Warbler, Sept. 25, 29, 30.
 Brown Creeper, Sept. 25.
 Snowbird, Sept. 26 to 30.
 Red-breasted Nuthatch, Sept. 28, 29.

Number of species seen each day:

Aug. 14, 18.	Sept. 7, 27.
“ 15, 26.	“ 8, 21.
“ 16, 27.	“ 9, 16.
“ 17, 30.	“ 10, 22.
“ 18, 29.	“ 11, 20.
“ 19, 31.	“ 12, 20.
“ 20, 27.	“ 13, 12.
“ 21, 25.	“ 14, 12.
“ 22, 32.	“ 15, 15.
“ 23, 25.	“ 16, 13.
“ 24, 19.	“ 17, 18.
“ 25, 25.	“ 18, 12.
“ 26, 25.	“ 19, 16.
“ 27, 25.	“ 20, 17.
“ 28, 23.	“ 21, 14.
“ 29, 25.	“ 22, 17.
“ 30, 22.	“ 23, 15.
“ 31, 22.	“ 24, 15.
Sept. 1, 28	“ 25, 19.
“ 2, 27.	“ 26, 12.
“ 3, 26.	“ 27, 14.
“ 4, 20.	“ 28, 14.
“ 5, 24.	“ 29, 16.
“ 6, 20.	“ 30, 12.

Total number of species seen, 65.

Rocky Mountain Botany.

A GENERAL REVIEW.

It is now just forty years since the present writer began his field studies of the vegetation of the Rocky Mountain region, in what was then Colorado Territory. In April, 1870, there were no public centers of botanical study, no libraries or herbaria, no resident students of the Rocky Mountain flora within the whole length and breadth of that land. There did not exist even the beginnings of any such thing as a local handbook of descriptive botany for the region, or for any part of it. To something like a comprehensive help to general plant study there, some approach was made a little later, in the Botany of Clarence King's Expedition, with its several very useful monographic supplements; but this book was not yet extant in 1870; and, until a much later date, the most ample library equipment for a student of Rocky Mountain botany could contain no books more serviceable than the two volumes of the unfinished *Flora of North America*, by Torrey and Gray, the botanical parts of several Pacific Railway Survey Reports, and certain monographs of western families and genera by Torrey, by Engelmann, and by Asa Gray, including the last named author's list of Colorado plants of Parry, Hall and Harbour, wherein a few new Colorado species had been described.

In this year 1870 it was the opinion of the highest authority that by the copious gatherings of Parry, Hall and Harbour, the botanical field of the Colorado Rocky Mountains had been well nigh exhausted. I have a letter from Asa Gray, written to me while I was still in Colorado in 1871, which closes with this remark: "I hope you will find some new species; but you will be sharp if you do." Three years later than this, namely in the beginning of 1874, there came forth from the Government printing office in Washington as a part of the U. S. Geological Survey Report, a thick pamphlet entitled, "A Synopsis of the Flora of Colorado." The author of this was Thomas C. Porter. The name of J. M. Coulter held a subordinate place on the title page; but every paragraph of original work was claimed by Professor Porter as his own. To those who knew the man, no question will be raised as to his sole authorship of the book. The work itself was of value to beginners in Colorado botany, notwithstanding that for all species of plants not peculiar to the region, reference was made to Gray's *Manual of the eastern botany* for the descriptions. To my own library the book was not a very significant addition, for the reason that at this time I had myself done

tenfold more work on Colorado botany than my friend Professor Porter had done. With the exception of eight or ten new species which had been gathered in southwestern parts of the Territory unvisited by me, most of the plants enumerated in the book were more familiar to me than to the author of the book, or to any other, for I had now devoted four years rather continuously to the study of this field, and had detected many plants which had not been found there by any of my more transient predecessors. These results of my researches, asked for by Professor Porter, found special mention by him in his Preface.

During eleven years next succeeding the appearance of this first Colorado Flora, I had traversed much of Colorado, Wyoming, California, Arizona and New Mexico. Within this period I had acquired a fuller knowledge of far western botany than had ever before been gained by an individual botanist; and the abundant new facts gathered, in as far as published at all, had been published in the main by Asa Gray; this also not so much by sending him new types as by indicating the characters of species already long in his possession, but, wrongly placed by him because of his failure to see the characters.

I shall never be chargeable with having been premature in making my beginnings at authorship on Rocky Mountain botany. To the study of this flora and other more or less related floras, to the eastward, westward and southward of it, I had devoted sixteen years; and a very considerable part of the knowledge gained so laboriously and devotedly, I had given to another to publish as his own. I was already 42 years old and more, when, in 1885, I published my own first paragraph of new Colorado botany.

Coetaneously with this little event, there came forth from the press a volume with the large title of a "Manual of Rocky Mountain Botany." Its author, in his Preface, commendably disclaimed any particular knowledge of the region named. Still, as a mere compilation from books and monographs by men accepted as authorities, the work must have subserved some useful purpose in the hands of plant lovers touring in the summer time in Colorado Mountains; people who could not have carried with them so conveniently the volumes of Gray's *Synoptical Flora*, and Englemann's quarto *Monographs*. I was located in California when this book appeared, and it found a place on my library shelves. This was a quarter century since; and, though during the whole of this period I have wrought more than any other upon Rocky Mountain botany, I doubt if I have consulted the book a half dozen times. For the real student of that flora there was nothing in it.

From 1885, another twenty years and somewhat more had passed when there was announced "A Flora of Colorado, by P. A. Rydberg," this in 1896. Those twenty years covered a period of the greatest activity of exploration and research into Rocky Mountain botany. Within those two decades more, and more effective, work had been done in that field than in the hundred years preceding them. My own contributions in California Academy Bulletins, in the five volumes of my *Pittonia*, and in earlier volumes of the journal *Erythea*, which I had established, will be cited henceforward for the greater part of this constructive work; and next after my own, both in point of time, and the amount of work accomplished, are the extensive contributions of Dr. Rydberg, in his "Flora of Montana," and in a long list of able studies published largely in the Bulletin of the Torrey Club. The call upon Dr. Rydberg to prepare a Colorado Botany came from the State itself; and he can not but have set his hand to the task with some enthusiasm; otherwise he could not have fulfilled it so well.

This Colorado Flora of Rydberg I cannot help thinking of as having made possible another book of Rocky Mountain botany, which, only three or four years behind it, has lately appeared under the title of a "New Manual of Botany of the Central Rocky Mountains." The authorship is divided between Professors John M. Coulter and Aven Nelson. It purports to be a new edition of the old compilation of 1885, yet is said to have been written entirely by my friend the Professor at Laramie, Wyoming; and it is about as different from the earlier book as can well be imagined; is even an incomparably more useful book; this notwithstanding that the earlier "Manual" was in a manner faultless, while this later one is full of faults.

However, the only book with which instructively to compare Professor Nelson's work is not the Rocky Mountain Manual of twenty years since, but Rydberg's Flora of Colorado, named above, and almost as recent.

The first of several contrasts that will be noted by one acquainted with the whole field will be in respect to the dimensions of the books; for the Rydbergian volume, embracing probably less than one-third the geographic area of the Nelsonian, and which ought to have been by much the smaller of the two, is manifestly the larger; and this despite the fact that in it there are no diagnoses of the genera or species, whereas in the other both genera and species are described, and that in no cramped or niggardly manner. But this contrast of dimensions might chance to prove of no great significance. In truth, the paper is thinner in the Nelsonian volume, also the type used is a trifle smaller. Yet again, the Rydbergian page

is both longer and broader. But we shall make a more fair comparison—at least a more significant one—by taking a census of the pages. The volume of the small territory has about 410 pages, that of the thrice larger, about 610. This, in view of the fact that in the book for the one state there are no descriptions, while in that covering almost four states as large, there are full diagnoses, is a contrast almost amazing; for, we who know well how speedily and multifariously environments change throughout the whole Rocky Mountain region, understand well that an honest flora of all Colorado, Wyoming and Montana, plus half of New Mexico and Utah, must embrace, if not twice as many plants as Colorado alone, at the very lowest possible estimate, one-third as many more. At this point we may take the testimony of each author himself as to the phytologic contents of the two fields so vastly unequal in extent. For Colorado alone, Dr. Rydberg enumerates 2,912 species; for the three of four times greater area, Dr. Nelson lists only 2,733 species; admitting, however, as by way of accounting for this astounding discrepancy that, of other—and we add, older and more experienced—authors' species he has reduced 1,788. These large reductions to synonymy include species by even that most conservative of American botanists, Asa Gray; also according to an estimate of my own, somewhat less than 400 species of Dr. Rydberg, whom I hear people speak of as having been Dr. Nelson's botanical father. If so, this will remind us of a common Old World plant which, in mediaeval Latin nomenclature, they called *filius ante patrem*. Such almost wholesale suppression of other men's contributions to Rocky Mountain botany will seem at first thought hard to excuse or condone; perhaps the more difficult after one has noted that the very few Coulterian as well as the multitudinous Nelsonian species are commonly maintained as valid. I doubt very much that any botanical community on either side of the Atlantic will be found to be of the opinion that Dr. Rydberg and I are the reckless species makers, and that Dr. Nelson is the careful, cautious and discrete conservative. I, who have noted the very beginnings of the botanical career of each man now active in North American botany, have no such opinion of my friend in Wyoming, nor, as I said, do I believe it exists anywhere.

Let us look now somewhat more closely into the question; and that by way of considering the membership of some particular genus. It may as well be *Senecio*, for that is a very ample one, and is abundantly represented in the Rocky Mountains. Going back a quarter-century into the past, and to a time when only one name of botanist now active in Rocky Mountain botany had yet been heard, we shall find that we

had then one standard book in which *Senico* was treated of and that for the whole of North America, north of Mexico. Gray's Synoptical Flora has of this genus, for the whole country only about fifty species. Of this number, by the way, one-tenth are therein credited to the present writer. They constitute the sum of all the senecios which, up to 1884, I had published; and Dr. Gray, above all American botanists, abhorrent of imaginary or feeble species, questioned the validity of none of them.

Coming down now from 1884 to 1906, a period of 22 years, Dr. Rydberg in his Colorado book, has 66 species of *Senecio*, a dozen or fifteen more than Gray had admitted for all North America. I note also here that not barely one-tenth but one-third of the Colorado senecios are mine according to Rydberg. But now, to the whole of Colorado, plus almost or quite thrice as much territory adjoining it, Dr. Nelson accords only about 40 species to the genus: two-thirds as many only, for the trebly extended area as for Colorado alone; and in the process of reduction of them for the Rocky Mountain Manual, some 15 of my senecios have fallen decapitate, and some 25 of those of my colleague Rydberg. The *Senecio* genus may be a not unfair example to have chosen by which to demonstrate how this book for almost the whole Rocky Mountains should not have been made a smaller volume than the one embracing Colorado only. Other large genera in families in which the bulk of later work has been done either by Dr. Rydberg or by myself, or by both, would probably yield similar statistics. Also, as somewhat in criticism of the able author of the Colorado Flora, I am bound to note here, what I have observed through many years, that he is too impatient, apparently, of studying descriptions. On this account he has published over again, as new, a rather long list of things which I had clearly published at earlier dates. Not a few of Dr. Nelson's reductions of Rydbergian species consist in a mere showing that I had published the same plant before. In *Senecio* one such case has remained undetected by the author of the later Manual. Both he and Rydberg have a *Senecio altus* Rydb. It is precisely the same as my *S. sphaerocephalus*, which was published four years earlier.

While we have still in mind this matter of the suppression of species for which the book is so conspicuous, let us not fail to note one circumstance that may seem to ameliorate the situation, or at least to mitigate in some degree the offense against men as able and as conscientious as any who have worked in this field. The writer of this Manual, quite unlike some of his contemporary authors, is careful to cite the place of the publication of such species as he suppresses. Really

this is the least that can be done in the spirit of justice to science and of honest dealing with one's fellow botanists. In this way it is made easy for any student to consult the descriptions of hypothecated or rejected species, and so he is helped to the means to form his own judgment about them. And the commendability of these bibliographic notes or citations is all then more manifest in view of the certainty that, occupying no inconsiderable amount of space, the cost of printing the book has been increased, and the profits from the copyright have been in the same ratio diminished.

Men have already criticized, and will further complain of, the unevenesses and inconsistencies of this book; the development of some of the plant families being according to the latest and best results of careful research, while other groups are left in a sort of archaic *status quo*. In the family of the boraginaceae, for example, there was a genus called by a barbarous name, *Krynnitzkia*, and credited with 11 species, this according to the old Manual, which same group in the new consists of the three genera *Allocarya*, *Cryptantha* and *Oreocarya*, with an aggregate of 33 species. By the same criteria, that is, by characters, both generic and specific that are of equal value, the genus *Polygonum* should have been resolved into the four genera of *Polygonum*, *Persicaria*, *Bistorta* and *Bilderdykia*, with increase of species nearly in proportion; yet the *Polygonum* of the new Manual differs from that of the old one in no respect except by the increase of the species number of 16 in the earlier to 28 in the later edition. And while such perfectly natural and marked genera as *Persicaria* and the others are ignored, such comparatively feeble generic proposition as *Anogra*, *Pachylophus*, *Lavauxia*, *Galpinsia* and *Sphaerostigma*, artificial and questionable segregates from the old *Oenothera* are sustained in the new book; and over against this rather forced segregation in the Onagraceae, there stands as of old the archaic and impossible genus *Rhus* of Linnaeus in the new volume, quite as in the old. Nevertheless, let no one who complains of these inequalities in the new Rocky Mountain Manual attribute them to that work as peculiarities. There are other books of the kind, too many of them, that have the same fault.

We have now, and almost all at once, also after long waiting, two highly serviceable octavos of Rocky Mountain systematic botany. We have rejoiced and shall rejoice in both of them. Moreover, we shall be glad again, and more glad, perhaps, when Dr. Rydberg's long hoped for volume—or volumes—on the same great flora shall have appeared.

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Banister's Catalogue of Virginia Plants.

Jacques Philippe Cornut's *Historia Plantarum Canadensis*, published in Paris in 1635, is undoubtedly one of the earliest records of North American plants. This work contains descriptions and illustrations of many species, the geographical range of which include not only New France, but also New England and the territory southward to Virginia, and the Carolinas. We could mention several species which are common or at least not rare within the borders of Maryland and Virginia, but will content ourselves with two striking examples, namely: "Filia baccifera" (= *Cystopteris bulbifera* L.) and the strikingly beautiful "Adiantum americanum" (= *Adiantum pedatum* L.) the latter being one of our characteristic ferns of low, deciduous woods.

In 1640, Parkinson published his *Theatrum Botanicum*, wherein he records many plants from Virginia. We may cite again *Adianthum fruticosum americanum*. The weird, but beautiful *Juniperus virginiana*, the characteristic ornament of the lower Potomac region and elsewhere is mentioned in this work. Virginian plants are mentioned in many other works, but the earliest *list* of plants from our region is contained in Ray's *Historia Plantarum* (vol. 2; pp. 1926-1928, 1688). This list is known as Banister's Catalogue and is of special interest to those who devote themselves to the Botany of the middle Atlantic States.

Of Banister we know very little except that he lived and labored in Virginia. Ray pays him a tribute in his *Historia Plantarum* (vol. 3; IV, 1704); "D. Joannes Banister primi sub-sellii Botanicus, Vir magni nominis & famae, quem Historiae hujus initio laudavimus. Virginiae ubi per plures annos sedem fixit, plantas mira industria indagavit & descripsit, rarioresque propria manu ad vivum delineavit; infelici tandem & deplorando casu antequam Historiam Naturalem istius provinciae, quam prae manibus habuit, perfecerat, dum rupes incautius scanderet, rebus humanis exemptus est."

A brief sketch of Banister's life was given also by Pulteney (Hist. & Biogr. Sketch 2:55-57, 1790).

In examining the catalogue anyone who is somewhat familiar with the plants of our region would at once recognize many of the species. The task of identifying a number of them, however,

would be a difficult one, for it would require a careful study of the prominent authors of that period. The method of description of two centuries ago presupposes an intimate knowledge of the older masters, and their terminology. This is readily seen if we examine Banister's second species: *Alsine Beccabungae folio*. The expression serves both as a name and as a description, wherein a knowledge of another plant, *Veronica beccabunga*, is prerequisite.

Among the species which are readily recognized, we may mention a few; *Castanea pumila racemoso fructu parvo in singulis capsulis echinatis unico*. The Chinquapin, is our common *Castanea pumila*; *Clematis purpurea repens petalis florum coriaceis* is *Clematis viorna* L., while *Clematis erecta, humilis non ramosa, foliis subrotundis, flore unico ochroleuco* is *Clematis ochroleuca*.

Dens caninus flore luteo which is blooming now in our beautiful woods, is none other than the dog's tooth violet—*Erythronium americanum*. The old name of this plant has evidently survived in popular nomenclature.

Filix mas rachi seu nervo medio alato is evidently *Phegopteris hexagonoptera* and the very interesting little walking fern, *Camptosorus rhizophyllus* cannot be disguised under its Banisterian name—*Phyllitis parva saxatilis per summitates folii prolifera*.

Banister mentions all of our species of Araceae except the very few rare forms.

The genus *Quercus* is interesting. Here we find a clear case of popular names translated into Latin: " *Quercus variae species*, 1. *Pumila*, 2. *Alba*, 3. *Rubra*, 4. *Hispanica*, 5. *Castaneae folio*, 6. *Lini aut Salicis foliis*, 7. *Fruticosa*."

Ulmus fructu Lupulino is our common Iron-wood—*Ostrya virginiana*.

In the December number of *Torreya** Dr. Barnhart, discussing "Some American Botanists of Former Days," reproduces for the "first page of Banister's Catalogue" what really is the title page of the second volume of the "Flora Virginica" of Gronovius. That the reproduction in *Torreya* is not Banister's first page seems self-evident, and we wonder how such a mistake was allowed in print. We herewith reproduce part of the real "first page."

* *Torreya*, Vol. 9, No. 12, p. 243.

E Catalogo *huc transmesso Anno 1680.* quem compositus
eruditissimus Vir & consummatissimus Botanicus
D. *Johannes Banister* Plantarum a seipso in Virginia
observatarum.

A Lfine Spergula trifolia reptans
Beacabunge folio.

Althaea lutea Pimpinella majoris folio, floribus
parvis, femoribus rotatis. Folia hujus plantae
pediculis infidient.

Althaea magna Accis folio, cortice Cannabino,
floribus parvis femina rotatim in fumitate
caulium, singula singulis cuticulis rotatis co-
opera ferens.

Althaea magna quinquecapitularis, cortice Cannabi-
no, foliis integris subtus, albiscantibus, floribus
magis ex fundo faturatis rubro albis.

Althaea magna quinquecapitularis, cortice Cannabi-
no, foliis Malvarum modo divisis, subtria-
nitibus.

Ambrosia inodora foliis non divisis.
gigantea inodora foliis alperis trifidis.

Anchusa lutea minor, quam Indi Paccoon vocant
teipso ea pingentes.

Anemone laetitia sylvestris alba.

Apocynum erectum non ramosum folio subrotun-
do, umbella florum rubris.

Apoc. erect. non ramol. latiore folio, umbella
florum albiscantibus.

Apoc. erect. minus. umbella florum candida

Conyza cerulea acris Americana
Cucumis fructu minimo vindi, ad maturitatem
perduto nigricante. Fructus Bryoniae albae
sacci non multo major est, cuius primo aspectu
speciem esse putaveram

D.
Dens caninus flore luteo.

Digitalis flore pallido transparenti, foliis & caule
mollis hirsutis imbutis.

Digit. rubra minor, labiis florum patulis, folius
parvis angulis.

Digit. lutea clavata Jacei nigri foliis.
lutea altera, foliis tenuis diflectis thecis
florum foliaceis
parva como coccineis.

E
Eryngium campestre Yucca foliis, spinis tenellis
hinc inde marginibus appositis.
Euonymus capulis elegante bullatis.

F.
Filius mas foliis integris auriculatis,
mas rachi fca nervo medio alato
femina foliis per margines pulverulentis

PLATE XIV. PART OF THE FIRST PAGE OF BANISTER'S CATALOGUE
Fac-simile from "Historia Plantarum" by John Ray, 1688.

